INTERNATIONAL TRADE ADMINISTRATION

2015 Top Markets Report
Cold Chain

A Market Assessment Tool for U.S. Exporters

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Executive Summary and Key Findings

The development of cold chain systems is a force multiplier that can generate exports and open new markets over multiple sectors over an extended period, rather than a one-off export transaction that can be quantified simply as an export success. U.S. businesses understand the need for viable and efficient cold chain systems; they spend hundreds of millions of dollars each year to build and maintain cold storage and transportation systems which allow U.S. businesses to flourish. Export promotion and trade policy agencies should focus on the development of international cold chains through improved regulatory environments, increased skill level of workforce, and encouragement of infrastructure investment, thereby promoting the benefits of U.S. services.

Cold chain systems are crucial to the growth of global trade in perishable products, and to the worldwide availability of food and health supplies. Each year billions of tons of fresh food products and millions of dollars' worth of U.S. exports are lost due to poor cold chain systems in developing markets. Globally, billions of dollars are spent on improving agricultural processes to create higher food yields, while the fact that nearly half of all food never makes it to a consumer's plate is ignored.[1]

Global losses in the food industry total more than $750 billion annually.[2] These losses primarily result from lack of proper facilities, improper food safety handling procedures, and insufficient training for those personnel working in the cold chain. Additionally, nearly $130 billion of annual medical, biologic and pharmaceutical sales are dependent on cold chain logistics to ensure the efficacy of their products.

While the concept and technology for controlling the temperature of sensitive product has been well-established for more than a decade, the development of cold chain systems as an industry sector is a new field, especially in terms of government policy. The United States has a competitive advantage in cold chain systems derived from some of the most advanced technologies and logistics management services in the world.

This report assesses the global market opportunity for U.S. manufacturers and service providers in refrigerated supply chains (cold chain), primarily for U.S. Government (USG) decision makers and to help companies find market opportunities.

The report details the basis for understanding the industry and developing export promotion strategies. It is driven by developments in supply chain technology and its many linkages to other industry sectors and potential exports of services and manufactured goods, for the cold chain area itself and for other sectors dependent on the systems.

The report assesses market opportunities in 18 countries, drawing from well-known World Economic Forum/World Bank rankings, industry criteria for selecting locations for investment, and private sector estimates of business potential. The methodology section sets out regional assessments of the markets for these indicators and then examines individual markets in more depth. Case studies were developed for 9 countries chosen based on interest expressed by government or private sector representatives to the International Trade Administration's (ITA) Supply Chain Team.

Ultimately, the report finds that there are significant opportunities for U.S. cold chain system exports in key growth markets. These opportunities may not be quick or easy to achieve, but they represent a potentially strong long-term payoff for U.S. business. Today the global asymmetry in cold chain capability and development tends to limit temperature-controlled U.S. exports.

Figure 1: Projected Cold Chain Export Markets

Australia	Indonesia	Poland
Brazil	Japan	Singapore
Canada	Kenya	Thailand
China	Malaysia	United Arab Emirates
Germany	Mexico	United Kingdom
India	Netherlands	Vietnam

Growth and Size

Cold chain markets that support perishable food distribution globally are estimated to be valued at nearly $250 billion.[3] Experts also estimate that cold chain in support of healthcare industries is worth more than $7 billion.[4] The compound annual growth rate (CAGR) of cold chain markets is anticipated to reach nearly 16 percent over the next 5 years.[5]

The United States is a world leader in developing the technology and processes necessary to develop and manage cold chain systems efficiently, and therefore the U.S. is well-positioned to capture a large share of the global market for cold chain development. According to the Global Cold Chain Alliance, an industry association comprised of the many industries that make up the cold chain sector, global refrigerated warehouse capacity increased by 20 percent from 2012 to 2014, and three of the top five refrigerated warehouse operators by total volume are U.S. companies.[6]

Features

Cold chain systems are critical to the operations of U.S. franchisors and retail service providers. Modern retail sales have been growing at a rate of 10-15 percent, and have reached 50 percent of market share in most of large emerging markets.[7] U.S. franchise brands for food concepts are known for quality and safety around the world. In order to maintain their reputations, franchisors must have reliable and safe means to transport products to their retail operations.

In less-developed economies retailers and franchisors have had to invest large sums of money in developing their own cold chain logistics systems. While companies like Walmart, McDonalds and YUM! have the necessary capital to establish cold chain systems for their operations, the lack of cold chain development more broadly in many countries represents a significant limitation for many U.S. companies, especially small and medium size enterprises (SMEs) attempting to expand into international markets.

Transportation costs are often the most challenging obstacles to suppliers in developing countries.[8] In countries with well-developed cold chains, most retail and franchise service providers outsource their logistics to third party logistics providers (3PLs) and to service providers that meet their standards.

Many pharmaceutical, vaccines, and biomedical products must remain within a limited range of temperatures to maintain their viability. U.S. express delivery service providers such as FedEx and UPS have made huge investments to develop complete logistics systems throughout the world which maintain the integrity of the vaccines and other healthcare products that they transport. These systems include warehouses, specialized aviation and ground transportation equipment, advanced software management systems and extensive personnel training.

Refrigerated Warehouse Capacity Growth by Country	CAGR 2008-2014
India	43 percent
China	35 percent
Mexico	27 percent
Brazil	26 percent
United States	9 percent

Opportunities for U.S. Exports

Developing cold chain systems provides export opportunities across the services and manufacturing spectrum. Cold chain-related design and engineering, maintenance, logistics and software and IT development amount to billions of dollars of U.S. services exports each year. Manufactured products like industrial racking systems, forklifts, trucks and commercial HVAC systems also could contribute to billions in direct U.S. goods exports.

The markets opened through efficient international cold chain systems will allow U.S. franchisers and retailers to continue to expand the services trade surplus that the United States has held more than four decades. Finally, the expansion of U.S. cold chain system exports will help U.S. agricultural producers expand their market opportunities overseas.

What is Cold Chain?

A cold chain system is a series of storage and distribution activities designed to ensure ideal storage and transportation conditions for temperature-sensitive products. With dozens of U.S. export industries depending on the vital links that cold chain systems provide, U.S. businesses invest hundreds of millions of dollars in their cold chain operations to create efficiency and reliability. However, an end-to-end cold chain is only as efficient and secure as the weakest link in the system. Each link in the cold chain must maintain the same level of integrity for the customer to receive a

Figure 2: Cold Chain System

satisfactory product. A single breakdown in the chain can result in catastrophic losses of product.

Requirements for cold chain facilities vary based on the size, type and amount of product. Fruits and vegetables often require cool facilities and will be stored around 55°F. Most dairy products require temperatures just above freezing, around 35°F. Meat and poultry products are typically stored just below freezing, at approximately 28°F. Ice cream and other frozen products may require deep freezing, at temperatures that can range from -10°F to -150°F.

Cold chain systems require industrial designers and engineers to develop efficient warehousing and storage systems, as well as refrigeration units for transportation vehicles and networks. Engineers and industrial design teams take into account what type of product will be stored in a warehouse facility; how much processing will be done within the facility; the quantity of items to be stored; and the product's specific handling requirements. Many facilities hold varying types of product sizes and handling requirements, and the design of these warehouses will often take into account the need for flexibility in cooling and handling conditions. A cold warehouse and storage system may cost several million dollars to design and build. These sales and services help contribute to the $3.4 billion in U.S. industrial engineering exports[9] and $184 billion dollars in industrial equipment exports in 2012.[10]

Once these systems are in place, cold chain warehouses require maintenance and repair services. Freon based systems are affordable option for small scale chiller systems; however, ammonia-based refrigeration systems have long been the industry standard for large industrial refrigeration. U.S. companies have also developed new technologies for small charge ammonia systems that use up to 98% less ammonia and can replace older, inefficient systems.[11] All of these systems will require regular maintenance performed by skilled professionals. Due to ammonia's hazardous qualities, safety and administrative controls must be implemented for equipment maintenance and service. The United States exported $16.2 billion worth of maintenance and repair services in 2014[12] – a number that ITA expects to increase, as additional cold chain development takes place in emerging markets.

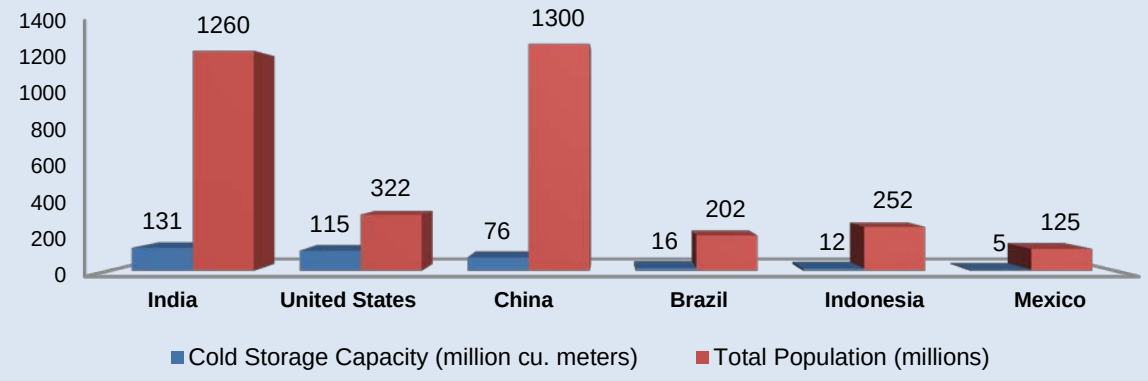
In a cold warehouse, forklifts and trucks are needed to move and store pallets of products. These trucks vary significantly based on the type and design of a cold chain facility. Additionally, refrigerated transportation equipment such as refrigerated or 'reefer' trucks will be required to transport products to retailers, franchisers or end users.

Modern refrigerated trucks, known as reefers, are designed to be very versatile and can be configured in minutes to carry a wide variety of cold products. Many trucks can carry products of varying refrigerated temperatures by adjusting internal compartments to meet specific product temperature needs. Often modern trucks are fitted with GPS monitoring systems that can provide data on location and can help operators maintain the temperature in individual compartments. Individual trucks can cost between $30,000 to well over $150,000. Warehousing vehicles and reefer trucks helped contribute to $21 billion worth of trucks, buses and special purpose vehicles exported from the U.S. in 2014.[13]

Managing cold warehousing and delivering products is often contracted out to 3PL operators, which provide important service export opportunities. 3PLs offer outsourced logistics services scaled and customized based on the needs of the customers they serve. Their expertise in management and transportation logistics and economies of scale often provide services at a lower cost than customers can provide for themselves.

In addition, express delivery service providers also have cold chain logistics services that are expanding internationally. Express delivery service providers can deliver high-value temperature sensitive products--primarily vaccines, medical and biotech products--by air

Figure 3: Cold Storage vs Total Population



to facilities around the world. These transportation services contribute to the $60 billion of U.S. exports seen in road freight services and airfreight services in 2014.[14]

Managing and coordinating the warehouse and transportation services necessary to maintain proper product temperatures is aided through advanced logistics and warehouse managing software. While some logistics service providers develop their own proprietary software, many rely on IT and software service provided by technology companies. U.S. inventory and transportation software system exports are classified as exports of computer software systems, which totaled $42 billion in 2014[15]

Once in place, cold chain systems make it possible for U.S. exporters to reliably ship meat, poultry, fruit and vegetables. Various forms of frozen and fresh food, wine and other beverages can also be exported through these advanced systems. In 2014, nearly $200 billion worth of food products were exported. Cold chain systems also allow U.S. pharmaceuticals, biotech materials and some sensitive electronic equipment to be exported safely.

Cold Chain Structure

The exact structure of each cold chain varies significantly depending on product and customer requirements. There may be many levels of processing and numerous stops between the product's maker and its final user. The goal of a properly designed cold chain system is to safely move temperature sensitive-products in a way that reduces waste, maintains the quality and integrity of the product, and limits opportunities for bacterial contamination.

A complete cold chain system may include post-harvest pre-cooling or freezing, processing, temperature controlled warehouse or storage, retail or distribution and refrigerated transport between locations.

Each cold chain varies by region, location and temperature requirements; however, ensuring a cold chain for agricultural products begins at the farm. Produce often goes through precooling at the harvest location and is then loaded onto a truck or other transportation unit designed to keep the produce protected from the sun and held within a desirable temperature range as it travels to a processor facility or a temperature controlled warehouse. In less-developed locations, transportation may be carried out on covered trucks or smaller carts; in more developed locations, these transportation solutions can include insulated reefer trucks.

Depending on the type of product and its ultimate destination, a product may proceed to one of several types of facilities. A cool dry storage facility protects the product and keeps it from high temperature fluctuations and humidity. A cold storage facility may be appropriate for products that require a lower temperature to remain fresh. This reduces the chance for bacterial introduction. A super cold facility is designed for products that may need to be kept frozen. Sometimes these temperatures may be 100° or more below zero. At each of these facilities, the product is kept at the ideal temperature until it is loaded onto an appropriate vehicle and shipped to a distribution center or its final destination such as a retailer or restaurant.

At the retailer or restaurant, a product must be stored at the appropriate temperature in a refrigerator or freezer as it awaits its final user, typically a home use customer or restaurant customer.

In the United States, cold chain systems are well-developed through many years of investment. This benefits U.S. consumers. In fact, in 2008, the World Health Organization attributed refrigeration as a major factor in the reduction of stomach cancer by nearly 90 percent in the United States since 1930.[16]

Cold chains in the United States are designed to meet high demands from businesses, consumers, and regulators. Businesses require products that meet the level of quality of their business structure; consumers demand the highest quality available based on the price they are willing to pay; and regulators such as the U.S. Department of Agriculture (USDA) and U.S. Food and Drug Administration (FDA)set requirements and minimum safety standards for the handling of many consumer foods and temperature-sensitive products. These market demands have resulted in a competitive U.S. industry, with standards that lead the world in terms of safety and integrity.

U.S. cold chains have reshaped the consumer market over several decades. Product seasonality issues rarely exist in the United States today, as retailers are able to source from countries with alternate climates. USDA forecasts imports of these products to reach $116 billion in 2015. Global trade in perishable products has continued to grow year after year.

Flowers are an example of a product that utilizes and depends on cold chain storage. Cold chain storage permits flowers of all varieties to be purchased year round, by sourcing them from South America and keeping them fresh through the extensive U.S. cold chain. The United States imports more than 5 billion fresh cut flowers each year.

Due to improving technologies in cold transportation, flowers are increasingly being transported to the U.S. via ocean going vessels, rather than the traditional, more expensive air transportation option. In fact, global shipments of all perishable products by ocean carriers has increased rapidly over the last 35 years.[17] Reasons for the shift include greater availability of refrigerated containers, improved facilites at ports, and better technology options for monitoring shipments in route.[18]

Fresh Cut Flowers Imports: 2014 Valentines Season By Country of Export[1]	Jan 1-Feb 14 2014 (millions)
Colombia	505.9
Ecuador	184.2
Mexico	43.1
Netherlands	21.3
Costa Rica	9.5
Kenya	8.3
Thailand	7.6
Guatemala	7.1
Peru	1.7
India	1.7

Exports of products from the U.S. to many of the sourcing countries for fresh agriculture products are still limited, due to inadequate distribution cold chains outside of the United States.

Leading Global Firms

Due to the cold chain system sector's multiple industrial components - including logistics, transportation, distribution, and equipment and technology industries – it is difficult to describe the industrial nature of the global cold chain sector in general or structural terms. The following is a snapshot of the cold chain sector's warehousing, third-party logistics, express delivery, industrial transportation equipment, and personal protective equipment subsectors.

Warehousing

Americold Logistics, based in Atlanta, GA, is by far the largest firm in the cold storage and 3PL logistics sector. The company operates nearly 1 billion cubic ft. of refrigerated storage, with more than 230 facilities, and has almost $1 billion in annual sales. Outside the United States, the company has operations in Argentina, Australia, China and New Zealand. Americold supplies more than 3,000 customers, including Tysons, Heinz, Con-Agra, and General Mills, with more than 90,000 freight shipments each year.[19]

Cold Storage By Volume	Storage (M/m^3)	Sales Revenue (millions)
Americold (U.S.)	950	$959
Lineage Logistics (U.S.)	544	$206
Swire Cold Chain (H.K.)	305	N/A
Preferred Freezer (U.S)	259	$59
Nichirei Logistics (Japan)	152	$188

Other major refrigerated warehousing providers include Lineage Logistics, Swire Cold Chain Logistics, Preferred Freezer, and Nichirei Logistics. Lineage, based in California, primarily operates in the U.S. It operates 544 million cubic feet of storage. Lineage had earnings of

$206.4 million in 2014. Swire Cold Chain Logistics, based out of Hong Kong, operates in Australia, China, Sri Lanka, the United States, and Vietnam and has 305 million cubic ft. of storage. Preferred Freezer, based in Los Angeles CA, has 260 million cubic ft. of cold storage mostly near freight hubs in the United States, China and Vietnam where it also provides cross docking and transshipping services. Nichirei Logistics, with 152 cu ft., is the logistics subsidiary of Nichirei Corporation in Japan, a food processor with nearly $5 billion in annual sales.

Third Party Logistics

Third party logistics operators (3PLs) provide integrated warehousing and transportation services to businesses on an outsourced basis. The availability of 3PL services allows businesses to focus on their core competencies while having 3PL's specialized systems handle most or all of their logistics requirements. These services can often be customized for individual clients based on the client's specific needs. 3PL services can include air, rail, maritime and truck freight; brokerage and customs services; warehousing; and distribution and in-bound and out-bound freight consolidation. Shipments via 3PLs rose 7.2 percent in the second quarter of 2014, according to the Transportation Intermediaries Association.[20]

Top 10 International 3PL's	Sales Revenue (millions)
DHL Logistics (GER)	$36.8
Kuehne + Nagel (SZ)	$22.6
DB Schenker Logistics (GER)	$18.9
C.H. Robinson (US)	$11.0
CEVA Logistics (NE)	$8.5
DSV (DEN)	$8.1
Panalpina (SZ)	$7.3
Dachser (GER)	$6.5
Expeditors International (US)	$6.1
SNCF Geodis (FRA)	$6.1

According to the Journal of Commerce, revenue from the top 40 logistics companies was over $225 billion in 2013.[21] C.H. Robinson Worldwide led U.S. logistics companies with $13.4 billion of sales revenue in 2014. With few physical assets of its own, C.H. Robinson contracts with more than 63,000 carriers around the world to manage 10 million shipments to more than 46,000 customers.[22] C.H Robinson buys, sells and transports food and agriculture products around the world.

Express Delivery Services

United Parcel Services' (UPS) subsidiary, UPS Supply Chain Solutions, is one of the top 3PL service providers, though UPS' primary focus is as an express delivery service provider that transports more than 17 million packages per day to over 220 countries. The company operates more than 96,000 vehicles, over 500 aircraft and exceeded $58 billion in sales in 2014.[23] UPS has developed Temperature True, a packaging and transportation system that provides services to more than 500 healthcare companies. UPS has developed 49 facilities dedicated to the temperature sensitive healthcare industry with cryogenic freezing to -150°F.

Express Delivery Services	Sales Revenue
Deutsche Post (Ger)	$75.83B
US Postal Service (U.S.)	$65.71B
UPS (U.S.)	$58.23B
FedEx (U.S.)	$45.57B

Another major U.S. service provider is FedEx, which delivers more than 3.5 million packages per day to more than 220 countries. With more than 55,000 vehicles and over 650 aircraft, FedEx generated more than $45 billion in sales in 2014.[24] FedEx has also rapidly developed logistics hubs throughout the world catering to temperature sensitive transportation, and uses a system called SenseAware that can monitor product vitals of humidity, barometric pressure, location, light exposure, at temperatures as low as -238°F.

Within the United States, both companies have established customs clearing processes and host U.S. Customs and Border Protection (CBP) offices within their facilities to allow international deliveries to proceed smoothly, without delays that could potentially expose sensitive products to risk.

Industrial Transportation Equipment

One of the largest U.S. manufacturers of reefers, or refrigerated trailers, is Utility Trailer Manufacturing based in California. The family-owned company has more than 140 brands, and had sales of nearly $500 million in 2014 and also builds specialized refrigerated vans and delivery trucks.[25] Other manufacturers of refrigerated trailers and commercial trucks and vans include: Wabash National with a variety of manufactured products; J.B. Poindexter which focuses on specialized trucks and vans; and Great Dane Trailers

Refrigerated Transportation Manufacturers	Sales Revenue (millions)
Wabash National	$1,635.6
J.B. Poindexter	$708.0
Utility Trailer Manufacturing	$497.8
Thermo King	$385.5
Great Dane	$221.2

with a variety of dry bed, flatbed and refrigerated sales. Companies like Thermo King, a division of Ingersoll Rand, provide temperature control systems for trucks, trailers, rail cars and shipping containers. In 2014, Thermo King had $386 million in sales.

Personal Protective Equipment

There are also a number of SMEs in the U.S. cold chain sector. For example, Georgia based Refrigiwear provides Personal Protective Equipment for workers operating in the cold environments of warehouses. The 55-year old company employs 100 workers and had $7.4 million in sales revenue from their 82,000 square foot facility.[26]

Assessing Export Market Opportunities

U.S. businesses engaged in international cold chain activity assess markets against specific criteria when selecting locations for expansion. The four primary criteria, according to industry sources, include the governmental regulatory environment; whether there is a trainable skilled labor force; the infrastructure environment; and the potential demand within the country or region.

Government/Regulatory

The first aspect that U.S. industries consider when looking at a new market is the regulatory environment of the country. In particular, U.S. industry looks for a stable government with transparent policymaking and for Sanitary and Phytosanitary (SPS) regulations and food safety requirements that are grounded in science based standards and industry best practices. Legal frameworks that allow companies to resolve legal disputes and challenge regulations are essential when identifying potential export markets.

Labor Force

Another important aspect for market decision-making is the quality and skill level of the potential work force in the market. Industry must have the capacity to train and develop the talent and the management required to run an efficient supply chain operation.

Infrastructure

The infrastructure within a country is another key aspect in a company's selection of export markets. Electricity and IT infrastructure must be sufficient to support logistics operations. Transportation infrastructure must be capable of supporting the reliable distribution of a product within the country or region without excessive delays. The International Association of Refrigerated Warehouses has noted a strong correlation of cold storage capacity to a country's transportation score in the World Economic Forum's Transport Index.[27]

Demand

Finally, the demand within a country must be considered. The potential size of the market will depend on consumer needs, the number of consumers in the country, products produced and demanded by the market, as well as the level of development within the market.

Methodology

When determining which global markets policy-makers should target for export promotion and trade policy activities, it is important to account for the primary decision-making criteria of U.S. businesses engaged in the cold chain market. In this report and the case studies that follow, the criteria for evaluating markets was based on the four specific aspects of *Government/Regulations*, *Labor Force*, *Infrastructure* and *Demand*. These are reflected in the report's scorecard and country case studies.

The scorecard for this report is based on the competitiveness index created by the World Economic Forum. By using this competitiveness index a cross-country analysis based on these market evaluation criteria is possible. Particular aspects of the index were used to represent the primary criteria that industry indicated as a priority in market selection.

The scorecard assigns a numeric value to each of the criteria on a scale of 1-7, with 7 being the highest score in a particular category. The scorecard is color-coded using green, yellow and red to indicate comparative values of countries in the same categories. It is important to note that the colors yellow and red do not necessarily represent a poor environment but rather represent the lower 40 percent of scores in the given region.

The case studies in this report analyze selected potential markets and assess important competitiveness factors. These case studies are intended to aid ITA in promoting the development of efficient international cold chains to improve U.S. export opportunities. Inclusion or omission of countries in the case study section does not necessarily indicate that these are the highest-ranked countries of opportunity, but rather that government or private sector representatives have expressed interest in these markets to ITA's Supply Chain Team.

Country Case Studies

The following pages include country case studies that summarize export opportunities in selected markets. The overviews outline ITA's analysis of the U.S. export potential in each market and represent a range of countries to illustrate a variety of points. The markets included in the case studies are representative of certain regions, and are not listed in any priority ranking order.

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Brazil

Brazil's culture, proximity to the United States and level of development make it a prime location for cold chain export growth; however, the effect of the regulatory environment on business development and difficulties in trade make any short to medium term growth diminutive.

Competitiveness Index	Score
Government/Regulatory	2.8
Labor Force	4.1
Infrastructure	4.3
Demand	4.7

Economic Statistics	
Population	202 Million
Cold Storage Capacity	16.0 M/m^3
Pharmaceutical Sales	$26.3 Billion
Mass Grocery Sales	$89.8 Billion
Food and Drink Imports	$4.7 Billion

In October 2014, the Brazilian Government published dietary guidelines that recommended the use of fresh foods over processed foods. The guidance suggests that improved cold chain development will be needed to meet the needs for fresh food.

Brazil has one of the lowest levels of market penetration for refrigerated warehouses at .09 cubic meters per urban resident, though the market has been growing at a rate of 26.5 percent from 2008-2014.[28]

Improvements to Brazil's government regulatory environment through trade facilitation can play a role in identifying where improvements can be made within the cold chain system.

Government/Regulatory

Refrigerated warehouse service providers face numerous challenges in the Brazilian market. Lack of understanding about the cold chain within the Brazilian government has led to inefficient rules and regulations. For example, a cool storage facility that distributes prepackaged goods may be required to abide by the same standards as a meat processing facility. As a result, employees are required to don full protective suits and their scrub boots and hands before entering or exiting the facility despite the fact that warehouse employees will never come in direct contact with any food or food products.

Customs issues, taxes and fees can limit opportunities for U.S. businesses and inefficient rules and regulations hamper growth opportunities for businesses engaged in cold chain operations.

Most warehouse facilities in Brazil lack sufficient fire suppression systems because regulations do not exist that require their use. Fire suppression systems, often developed and sold by U.S. companies, can be prohibitively expensive due to customs and importation taxes and fees. Technologies in cold chain management such as computer-based and GPS tracking systems are likewise expensive to acquire and use in Brazil, thereby limiting the speed of growth in the Brazilian market.

Labor Force

With a lower educated work force than other countries in the region, it is important for cold chain operators to perform a significant amount of on-the-job training.

According to Euromonitor International, the percentage of population age 15 or older that has a higher education degree is much lower than that of Mexico and Chile. The demand for skilled graduates has increased in many industries and there is a shortage of skilled employees, especially in the IT sector, that can help develop the Brazilian industry.[29]

Infrastructure

Transportation infrastructure in Brazil is a mixed bag of success and failures. Road transportation within and around major cities is often highly-developed, though traffic congestion is a major concern throughout most of the day. Distribution of products during off hours can be limited due to cultural aspects surrounding business practices and crime concerns.

Rail infrastructure is poorly developed and regulations surrounding management of rail lines make travel by rail a means of last resort only.

Demand

The Brazilian retail market is heavily saturated. The large metropolitan cities have limited opportunity for growth overall; however, fresh food providers and franchise and restaurant service providers may continue to see growth opportunities. Modern supermarkets have a market share of 50.7 percent, and have seen slow growth of about 1.3 percent over 2008-2013.

Mexico

Mexico's national economic growth rate and proximity to the United States make it a key market for export growth. Improvement in government regulation and streamlined border and customs programs would accelerate cold chain growth in Mexico.

Mexico has a great capacity for growth in the cold chain industry in the near future. Mass grocery sales in Mexico are expected to reach nearly $85B in 2015.[30] Retailers and franchisors in the food sector are focused on continuing the nearly 7 percent annual growth in food sales they have experienced for the last five years. While market share of modern supermarkets is low at 3.4 percent, Mexico has seen a growth rate of 54 percent from 2008-2013, and per-capita sales growth of 4.6 percent.[31] Pharmaceutical sales are expected to reach nearly $15B in Mexico in 2015.

Cold chain service providers are investing and growing to supply the infrastructure necessary to support these sales. The cold chain industry will likely continue to see growth of nearly 30 percent as Mexico upgrades its infrastructure. Maintaining a stable government and electricity supply, as well as improving transportation will be essential to sustain growth in this industry.

Government/Regulatory

Given the importance of the U.S-Mexico trade relationship, Mexican agri-business is highly dependent on trade with the United States. There has been a recent push in the United States to allow Mexican trucks to deliver freight directly to their customers in the United States. Given that most agricultural products in Mexico travel by truck and the United States is a large consumer of Mexican produce, there may be significant opportunity to expand cold storage facilities in regions which produce agricultural products that are exported to the United States. Many Mexican truckers, however, are not eager to apply for the cross-border trucking authorization because they believe the requirements are too stringent and that it is not economical to participate. An example of this is that Mexican trucks would not be able to deliver goods between U.S. cities, which makes it economically infeasible to operate in the U.S. as this would force the trucks to return empty if they could not obtain goods at the delivery destination to ship back to Mexico.[32]

Competitiveness Index	Score
Government/Regulatory	3.4
Labor Force	3.8
Infrastructure	4.4
Demand	4.5

Economic Statistics	
Population	125 Million
Cold Storage Capacity	5 M/m^3
Pharmaceutical Sales	$13.9 Billion
Mass Grocery Sales	$81.6 Billion
Food and Drink Imports	$22.8 Billion

Labor

Mexican SME's make up a significant portion of agricultural sales to U.S. retailers and franchises operating in Mexico. However, many SME's lack the efficient managerial skills to increase productivity. SME's also do not have a reference model to tell them how efficient their supply chain is.[33]

U.S firms have been supportive of developing Mexico's distribution system; Walmart's first store in Mexico was established in 1991. Since then, Walmart has worked with micro, small, and medium sized firms to develop their technical and logistics capabilities.[34] Growth in consumer income will lead to a growth in demand for food products; franchisers and other food retailers have significant opportunity to utilize a collaborative model when establishing cold chain infrastructure with Mexican farmers.

Infrastructure

Infrastructure is one area which has historically limited Mexican cold chain capabilities as transportation and infrastructure beyond major cities is lacking. Furthermore, cargo theft is a frequent concern and a huge entry barrier to the Mexican market, especially with high value products like pharmaceuticals. In the United States, pharmaceutical distributors typically

operate on low margins, and thus cargo theft may jeopardize the financial health of a distributor and cause distributors to charge higher prices to account for the risk.

According to Rx-360, a pharmaceutical supply-chain association, the threat of cargo-theft in Mexico is severe.[35] Given the high-value of many refrigerated pharmaceutical products such as cancer drugs, theft risk may factor into pharmaceutical firms' decisions when executing logistics operations in Mexico. Theft of food products is another obstacle to many firms.

Demand

As the Mexican economy continues to develop, demand for food products will continue to increase. Furthermore, given the U.S.-Mexico relationship, demand on the U.S side has a large impact in Mexico. Geographic proximity has made the United States and Mexico strategic partners in the food industry. Mexico is the United States' second largest food supplier totaling $17.7 billion in exports in 2013. Mexican demand for value-added food imports has grown rapidly in recent years as the introduction of supermarket food distribution systems has become more prominent.[36]

China

With a large, rapidly growing demand and well established infrastructure in large urban populations, China is a top market for cold chain development. Outside of tier 1 cities like Shanghai and Beijing, shipping of temperature sensitive products is extremely difficult. In these parts of China, the cold chain system is highly fragmented, often leading smaller companies engaged in the market to cut corners. As a result, the lack of internationally recognized best practices in cold chain operations has made reliably shipping temperature sensitive products costly and difficult.

China's rapidly growing middle class offers huge opportunities for retailers, franchisors and restaurant service providers to expand and grow. Pharmaceutical sales in China are expected to reach $110 billion in 2015 and food consumption is expected to reach over $960 billion.[37] U.S. franchisors and retailers have seen considerable growth in China, and per-capita grocery sales have increased at an annual growth rate of 7.6 percent from 2008-2014.[38] Refrigerated warehouse capacity has seen CAGR of 34 percent, and investments increased by $16 billion in 2013.

With continued improvement of the cold chain sector, U.S. SMEs are expected to find better opportunities to enter the Chinese market. Fresh food sale in China though E-commerce will increase demands on logistics providers within China, and poses a particular market of opportunity for U.S. cold chain system providers, especially 3PLs.

The need for cold chain service providers, refrigerated warehouses, 3 PL's and express delivery services will continue to expand at a rapid pace. Cold chain capacity may increase by as much as 20 times current capacity over the next decade. It is important that the emerging cold chain industry utilizes international best practices that U.S. businesses have come to expect, otherwise U.S. export expansion opportunities may be limited.

To help increase the use of international best practices in cold chain operations, a group of industry representatives and government officials under the American Cold Chain Working Group in Shanghai have been working together to discuss the timing and implementation of applying certain international best practices in the cold chain sector. The American Society of Transportation and Logistics has developed training and certification in logistics management and is considering working on a similar program for cold chain.

Competitiveness Index	Score
Government/Regulatory	4.1
Labor Force	4.3
Infrastructure	4.6
Demand	5.1

Economic Statistics	
Population	1.3 Billion
Cold Storage Capacity	76.0 M/m^3
Pharmaceutical Sales	$98.7 Billion
Mass Grocery Sales	$147.5 Billion
Food and Drink Imports	$62.0 Billion

Government/Regulatory

Lack of clear concise regulations and enforcement in transportation and cold chain logistics can lead to inconsistencies in quality and mistrust between businesses and consumers.

A lack of standardized health and safety regulations regarding the handling of food and temperature sensitive products means smaller logistics providers in China often cut corners to save costs. This acts as a trade barrier for any company entering the market with proper practices and equipment.[39]

U.S. businesses must be mindful of the challenge to find reliable suppliers that use proper practices and training; in 2013 a supplier sold KFC and McDonalds expired meat. This food safety scare hurt the brand reputation of McDonalds and KFC and led to a significant plunge in sales.

Labor

Lack of trained labor in the logistics industry has made business expansion difficult for many U.S. companies.

While China seems to have no shortage of available labor, the struggle of logistics companies to reduce costs often means lower levels of training for

employees. Cold chain operators may find a limited number of trained labor available for operations, and should therefore anticipate extensive amounts of training for all aspects of logistics and cold chain operation. Further work is necessary to improve logistics management and reduce barriers for entry for U.S. companies.

Infrastructure

China's infrastructure is well established in most urban locations. While congestion can be a major source of frustration, many logistics providers have developed solutions such as delivery by mopeds and scooters. Electricity in urban environments is generally stable, allowing cold chain providers the means to power the facilities necessary for operations. Due to the massive size of the country, infrastructure outside of the major cities, including transportation and electricity can sometimes be a challenge.

Demand

At 5.34 percent, the market share of modern grocery retailers is at the low end of the spectrum for all countries; however, this market share has increased at a rate of 64.9 percent from 2008-2013.[40] Many consumers outside of first tier cities still purchase agriculture and food products from a traditional wet market, limiting the full utilization of cold chains. On the other hand, major cities like Beijing and Shanghai have seen a dramatic increase in the demand for, and utilization of, cold chain warehouse and transportation systems especially as western businesses and cultural influences have become more popular and consumers are becoming educated and aware of food safety issues.

India

India's potential market size should make it near the top of the Top Market countries; however, constantly shifting regulatory barriers and complex tax schemes limit the large scale investments necessary to fully realize the country's potential.

India has been a disappointment for many service industries over the last several years as high expectations for greater export opportunities have not been realized. Despite some positive developments, including the Government of India's reduction of certain foreign direct investment (FDI) restrictions, retailers often remain reluctant to invest in the market. This is due to specific conditions, including greater capital requirements that are tied to foreign investments and constantly shifting barriers to access created by some government officials' stances in certain markets.

Competitiveness Index	Score
Government/Regulatory	3.8
Labor Force	4.1
Infrastructure	3.8
Demand	4.7

Economic Statistics	
Population	1.26 Billion
Cold Storage Capacity	131 M/m^3
Pharmaceutical Sales	$16.7 Billion
Mass Grocery Sales	$31.7 Billion
Food and Drink Imports	$11.3 Billion

India is one of the largest consumers of food in the world and is the third largest producer of agriculture. The food service industry is estimated to be nearly $50 billion and is anticipated to grow at 10 percent annually for the next several years. The Global Cold Chain Alliance estimates that the cold storage market in India has been growing at a rate of 25 percent per year, to reach $8 billion in 2014.[41]

Despite the growth, India sees nearly 40 percent of its produce go to waste annually due to inadequate cold chain infrastructure; one third of its losses occur during storage and transit[42]. Experts have estimated that India has less than half the cold chain capacity necessary to meet its current needs and will require as much as $100 billion of infrastructure investment over many years.

In 2013, *The Economist* published an article about the eagerness of western retailers such as Walmart, Carrefour and Tesco to penetrate the Indian market. These companies believe that they would revolutionize shopping in India, where only 2-3 percent of groceries are bought in formal stores.[43] The rest are purchased in the 12 million local markets which rely on an inefficient supply chain where farmers auction products to middlemen; often up to five middlemen can be involved with the distribution of a single onion. The farms themselves are small and do not have the economies of scale necessary to invest in cold storage, transportation or supply chain development.

The U.S. Government should continue to use commercial dialogue talks to ease restrictions to business, especially in the areas of FDI. Promotion of infrastructure development in the form of a modern electricity grid should also be a top priority.

Government/Regulatory

India's cold chain challenges are some of the most complex in the world. A critical first step to embarking on a sustainable path to cold chain development is allowing market forces to prevail and develop infrastructure which can set the foundation for future cold chain development. The Indian Government however, is still setting policies to favor SME's in the urban retail sector or western retailers.

According to the World Economic Forum, the small-scale and fragmented retail market in India prevents the scale of capital investment necessary to create a modern logistics system.[44]

India's regulatory burden is significantly more impactful than other developing countries where supermarkets have a much larger market share. One regulation imposed on multi-national firms is that 30 percent of

products in a store must be sourced from India; international retailers have found this policy unfair as domestic firms to not need to comply with this requirement, making competition difficult

India's current tax scheme has encouraged logistics companies to create small stocking facilities located throughout India's 30 states. The complexities of taxation and the subsidization rules of India's national government prevent the large logistics companies from creating economies of scale through efficient hub-and-spoke type distribution systems.

Protectionist methods of the Indian Government have prevented many Western retailers from entering the market, and have kept the market share of modern supermarkets in India down to an abysmal .05 percent; lower than virtually all other countries in the developed or developing world and with a growth rate at 4.3 percent,[45] it is unlikely much will change in the near future. In 2013, Walmart announced that it had indefinitely delayed its plans to open hundreds of superstores across India and thus terminated its joint venture with retail firm, Bharti.

E-commerce of food products has the potential to serve as a new market to improve consumer access to fresh foods within the country and boost investment into large scale cold chain systems. However, current legislation prevents FDI in business to consumer e-commerce sales.

Labor Force

Retailers such as Walmart claim that they would modernize logistics chains either by investing directly themselves or indirectly by collaborating with food producers to invest in warehouses and trucks while establishing direct contacts with farmers. According to one farmer, "Our biggest problem is illiteracy. We don't know how to use technology." If western retailers can establish collaborative partnerships with farmers, India's labor force may begin to see improvements.[46]

While some optimistic estimates expect the cold chain sector to grow to $12-$15 billion over the next five years, many large retailers, and large cold chain service providers will likely continue to hold off investing the amount of large scale capital necessary efficiently serve this market until restrictions are lowered and there are greater opportunities for return on investment.

Infrastructure

India's transport system needs significant improvements; many roads linking farms and cities can cause considerable delays in distribution.

Electricity infrastructure is extremely lacking and serves as the first impediment to integrating cold chain capabilities across the supply chain; many farmers do not have access to electricity. In 2012 India had a multi-day blackout which affected over 620 million people. Thus, companies involved with cold storage must invest in costly generators or risk losing their products in the event of electricity failure. Lastly, India's road, rail and port infrastructure is in dire need of repair, especially in rural areas.

Demand

India's domestic market size is strong, however, availability products at local suppliers can vary significantly due to a variety of transportation issues.

Indonesia

Indonesia ranks high in surveyed countries with a potentially large market primed for infrastructure investment. The organized retail sector has been growing at nearly 15 percent for the last four years and per-capita sales at modern outlets have increased 18.5 percent annually since 2008. Mass grocery sales are expected to reach nearly $40B in 2015 and pharmaceutical sales are expected to reach $6.2B in 2015.

Indonesia has a large potential for growth in the cold chain sector. The use of the country's abundant natural resources is limited by the poor infrastructure that prevents efficient exploitation. Significant opportunities exist for foreign retail food firms to enter Indonesia. In September 2014 SPAR International announced it would open 30 supermarkets over the next three years in Indonesia.[47]

A swiftly growing domestic market was cited in ranking Indonesia #4 by Agility in their 2015 Emerging Markets Logistics Index.[48] The index highlights markets that are primed for logistics investment. The U.S. Government should encourage continued liberalization of FDI and promote the investments that U.S. logistics companies can make into the market. Commercial dialogues in particular can highlight the need for improvements in labor restrictions.

Government/Regulatory

Despite the growth in supermarkets, Indonesia's government has interfered with hypermarkets--retail outlets that sell a large multitude of product categories--electronics, appliances, beauty products etc. in addition to food products. For example; in an effort to protect traditional markets Indonesia's government often prevents hypermarket stores from being built in city-centers. This has frustrated retailers interested in expanding their business operations.

According to the U.S Department of Agriculture, growth in the sale of refrigerated food products will most likely stem from the increase of modern food outlets. Furthermore, Indonesia's ports are under strict government oversight, limiting the expertise and investment that foreign port operators and investors can provide.

Infrastructure

Indonesia is in need of critical infrastructure upgrades to prevent further logistics bottlenecks. A report from Maersk Line cited a lack of equipment, low port efficiency and poor road access as reasons for congestion and sub-optimal port-efficiency. Delays make it difficult to keep produce fresh. One impediment to improving port infrastructure in Indonesia is a lack of liberalization in the transportation market which deters foreign port operators and investors from participating.[49]

Competitiveness Index	Score
Government/Regulatory	4.0
Labor Force	4.4
Infrastructure	4.6
Demand	4.6

Economic Statistics	
Population	252 Million
Cold Storage Capacity	12.3 M/m^3
Pharmaceutical Sales	$5.7 Billion
Mass Grocery Sales	$37.5 Billion
Food and Drink Imports	$14.8 Billion

Currently cold chain infrastructure is not adequate to meet the dairy and frozen food industry's requirements. This shortage may only get worse if Australia, New Zealand and Association of Southeast Asian Nations (ASEAN) sign a free trade agreement as it would likely increase the amount of dairy products transported through the country.

Indonesia has been described as a complicated market for foreign producers and distributors to maintain an advantage in due to geography and lack of infrastructure capabilities. There are 6,000 inhabited islands in Indonesia spanning 5,000 km from east to west, making it difficult to efficiently and quickly transport, store, and distribute temperature-sensitive products. Even consumers in Java which has most of the Indonesian population are difficult to reach because shoppers are spread out across the archipelago.[50]

Halal logistics, which is prevalent in Malaysia (see Malaysia case study), is becoming increasingly prevalent in Indonesia and is a trend to monitor. U.S firms that are unaware of the certification requirements and the special requirements involved in transporting, storing, and distributing temperature-sensitive halal products may be at a competitive disadvantage.

Labor

Indonesia suffers from severe labor rigidity. Labor regulation in Indonesia had led to excessive dismissal costs and limitations on contract expatriate employees.

Studies have found that farmers who participate in cold chain-based supply chain networks developed by modern retailers earn more profit for produce then when selling products that are sold in traditional retail settings. Furthermore, the Indonesian government's push for self-sufficiency in the agriculture sector is likely to promote more demand for labor sources in this sector.

Demand

Indonesia's retail landscape is dominated by small traditional shops with little variety or options available to consumers. Furthermore, shelf space is also limited which serves as a barrier to entry for many food producers wishing to sell products in the market. However, significant opportunities exist for food retailers to find ways to better serve these markets. One major selling point of modern food retailers is that they offer meat and produce products that have travelled through sophisticated cold chain systems. With traditional retailers, the consumer is unaware if the product in question has been refrigerated during its supply chain journey.[51] Within the larger metropolitan areas, fresh produce is often preferred by wealthier consumer groups. Given the rise in consumer income, ITA expects a commensurate increase in demand for cold products sold by modern retailers.

Malaysia

Malaysia's Competitive Index puts the country near the top in all categories. However, concerns over transparency may cast a shadow on the future growth potential.

Malaysia has the highest potential for cold chain sector growth in the ASEAN region. Quality products and the potential for trade within the ASEAN region make it a very attractive market for U.S. exporters. Though there will be a slowdown in retail growth from the implementation of new goods and services tax, the expected annual increase of 7 percent in consumer spending and a growing middle class over the next several years still represent a good opportunity for retail growth and imports from the United States.

Malaysia is a forerunner of the halal food production industry; this can represent an opportunity for refrigerated logistics services designed for the air transport market. Given demand for halal food products in Malaysia, cold chain logistics providers interested in entering this market should consider getting certified to appeal to all consumer segments.

Companies such as Tesco ensure that many of their goods are certified by local halal authorities. ITA expects Malaysia to become a global hub for halal products with its extensive product lines, halal distribution centers and government developed standards for being certified as a halal logistics firm.[52] Malaysia's own proprietary halal standards are different and stricter than other countries, including Saudi Arabia. Several U.S. producers which have been approved by Saudi halal authorities have not been approved by Malaysia. Malaysia's halal certifying authority JAKIM imposes additional requirements that can often increase the cost of production to U.S. companies and producers.

While halal logistics is supported by many consumers it requires the entire supply chain to adhere to certain principles; if one partner in a supply chain does not adhere to these principles the product cannot be labeled as halal. In the case of Malaysia, a partner in the supply chain that has been certified halal by a different authority (such as Saudi Arabia) will not automatically receive approval for Malaysia's halal standards.

Competitiveness Index	Score
Government/Regulatory	5.1
Labor Force	5.2
Infrastructure	5.5
Demand	5.1

Economic Statistics	
Cold Storage Capacity	N/A
Pharmaceutical Sales	$2.2 Billion
Mass Grocery Sales	$16.9 Billion
Food and Drink Imports	$11.2 Billion
Cold Storage Capacity	N/A

The U.S. Government should continue to use commercial dialogue and trade discussions to promote retail market liberalization and relaxation of labor market restrictions. The United States Department of Agriculture (USDA) and its Foreign Agricultural Service (FAS) are working with Malaysian officials concerning halal standards and certification issues.

Government

Malaysia represents an attractive opportunity for refrigerated logistics service providers to serve the growing pharmaceutical industry. The Government of Malaysia has announced that it will invest in the biotech sector to boost production capabilities.[53] It is worth noting that the Government of Malaysia has been a strong supporter of port development. In the franchising industry, Domino's has continued to expand operations in the historically less developed east coast of Malaysia. The Malaysian Government has been proactive in promoting infrastructure in this region and opportunity exists for cold chain services to conduct business in this region.

Researchers have found that lack of regulatory forms to facilitate the industry and lack of information sharing with regard to expansion and development of the logistics industry are constraints for industry.[54]

Trans-Pacific Partnership (TPP) negotiations final outcomes, including opportunity for investment in retail, will determine the openness of retail and franchise market. As such, the potential for cold chain logistics may be affected.

Labor

One challenge that firms face when entering Malaysia (especially SME's) is complying with labor regulations. The regulations make it difficult to hire expatriate employees and promote hiring ethnic Malay groups as opposed to other ethnic groups. Research has also found that there is shortage of skilled manpower in Malaysia.

Infrastructure

Malaysia's infrastructure is well developed and offers opportunity for cold chain development. The Malaysian Government continues to invest in the development of the infrastructure of the country.

Demand

There is substantial opportunity for cold chain expansion in the Eastern region of Malaysia and there are still significant opportunities for U.S. exporters to penetrate the organized food retail sector which accounts for less than half of grocery sales. Furthermore, the emergence of online shopping for groceries should create additional demand for refrigerated trucks and warehouses near major population centers. With respect to halal logistics, interest in halal foods has led to partnerships with food companies in other Islamic countries such as Qatar. This may create additional demand for refrigerated warehousing and containers in port areas.

Singapore

Singapore's well established infrastructure, favorable business climate and high per capita income make it a top market for cold chain. Its strategic location is ideal for cross docking and distribution networks to service the ASEAN region.

Singapore's retail food sector is one of the most advanced in the world. Mass grocery sales are expected to reach $3.7B and pharmaceutical sales are expected to reach $834 million in 2015.[55] The mature nature of Singapore's mass grocery retail sector is evidenced by intense competition, which ensures that retailers must be highly innovative to compete.

Because Singapore has one of the highest per capita incomes in the world, catering to consumer preferences rather than competing on price alone, presents an opportunity for U.S. exporters. E-commerce and direct to consumer deliveries of temperature sensitive products will find excellent opportunities in this market due to relatively lower overhead and real estate costs of operation, and the ability to cater to consumers that do not have time to shop at a retail store.

More than 72 percent of the population earns over $50,000 annually, presenting a high level of consumer purchasing power. Due to land constraints, as much as 90 percent of food consumed must be imported. Recent trends have shown Singaporean retailers sourcing more agriculture products beyond the region to meet the 5.5 percent annual increase demand of the local markets.

About 15% of Singapore's resident population is Muslim and as such, there is a relatively strong demand for halal food products in Singapore. Cold chain logistics providers interested in entering this market should consider getting halal certification to appeal to all consumer segments.

The U.S. Government should promote the advanced technologies and efficiency gains that U.S. logistics companies can provide. Continued discussion on development of single window systems to aid in custom clearance is also a priority that will facilitate U.S. exports.

Competitiveness Index	Score
Government/Regulatory	5.7
Labor Force	5.7
Infrastructure	6.4
Demand	4.7

Economic Statistics	
Population	5.5 Million
Cold Storage Capacity	N/A
Pharmaceutical Sales	$822 Million
Mass Grocery Sales	$3.6 Billion
Food and Drink Imports	$6.6 Billion

Government/Regulatory

Singapore has consistently been ranked as one of the most favorable countries to do business. One risk, however, that should be monitored is when purchasing property. Because land is so scarce in Singapore, numerous bidders often drive the price of land to above its real value, making it costly to develop sites and facilities needed for cold chain operations.

Trans-Pacific Partnership (TPP) negotiations final outcomes may create new opportunities for doing business in participating ASEAN countries including Singapore.

The Agro-Food and Veterinary Authority of Singapore (AVA) worked with the food industry and SPRING Singapore to launch a new Singapore Standard (SS) for the cold chain management of vegetables in 2013. Named SS 585: 2013, the new standard covers major supply links starting from the farm to the packing house, transportation, distribution, wholesale center and retail. This is especially crucial for Singapore, where more than 90 percent of fresh produce is imported. SPRING Singapore is now promoting international recognition and adoption of these standards through the International Standards Organization (ISO).

Labor Force
Singapore has one of the most expensive labor markets in the world. This may be a barrier to entry to SMEs looking to expand into this market.

Infrastructure
Singapore has a highly developed and sophisticated cold chain distribution system. Cold chain operators are looking at further developing their Singapore facilities to create a cross docking location to more efficiently move product throughout the ASEAN region, which would help U.S. cold chain firms improve their operating efficiency and market prospects in this region.

Demand
A well-established, mature retail industry means competition is intense. High per capita income means consumers are often focused on quality, higher margin products. Singaporean customers often value the ease of shopping in convenience stores or on-line. Packaged foods are an industry that appeals to this consumer segment as these products are easier and less time-consuming to cook. In the face of rising obesity rates, government initiatives and consumer choices to eat healthier have created demand for healthy processed foods.[56]

Wet markets in Singapore still represent a major point of sale for fresh grocery products. Wet markets are reminiscent of traditional markets and serve as a destination that sells fresh produce, meat and fish products. Older consumers tend to prefer shopping in these outlets.

There is also strong demand for fresh products in Singapore; even busy professionals who can't make treks to the markets frequently will buy fresh produce and freeze it themselves to consume later. Therefore significant opportunity exists for firms to sell food items which are both fresh and readymade or easy to prepare.[57]

Singaporeans also pride themselves on being a 'foodie' country and 60% of Singaporeans eat out at least four times a week according to the 2010 National Nutrition Survey. "Eating out" includes hawker centers, food courts, coffee shop stalls, restaurants, coffee houses and workplace canteens as usual meal venues. A recent MasterCard survey on consumer dining habits showed Singaporeans to be one of the top spenders for dining out across the wider Asia Pacific. There is also a recognizable shift towards fine dining, new cuisines and differentiated dining experiences among Singaporeans creating increased demands for new perishable food items.

Vietnam

Strong foreign infrastructure and logistics activity signal that Vietnam should be a growth market, though government regulatory concerns keep it on the lower end of this year's *Top Markets Report*.

Vietnam's organized retail sector is at the beginning stages of growth and most retailers and cold chain operators are continuing to monitor the development of the market. Mass grocery retail sales are expected to reach $8.7B and pharmaceutical sales are expected to reach $4.4B in 2015.[58]

The U.S Government should use commercial dialogues to encourage liberalizing the retail market, and to develop regulations that provide clear guidance to the business community.

Competitiveness Index	Score
Government/Regulatory	3.5
Labor Force	3.6
Infrastructure	3.8
Demand	3.9

Economic Statistics	
Population	95 Million
Cold Storage Capacity	N/A
Pharmaceutical Sales	$3.8 Billion
Mass Grocery Sales	$7.6 Billion
Food and Drink Imports	$5.5 Billion

Government/Regulatory

Vietnam still remains a relatively risky place to do business, as laws and regulations are not always transparent. Furthermore, there are restrictions on forms of foreign direct investment that deter some retailers from entering this market. The Vietnamese Government has taken a proactive step to promote cold chain infrastructure by introducing financial incentives to attract foreign investment. Vietnam's government has also made it a policy initiative to promote the rapid growth of infrastructure and attract many of the world's largest infrastructure companies; as a result, many 3PL's have benefited.[59]

Labor

According to research from the *Quality Management Journal*, many managers see little incentive to improve company processes. This has led to a productivity challenge in Vietnam. Companies wishing to expand to Vietnam should invest resources in training management to identify areas for improvement and taking action.[60]

Infrastructure

Foreign logistics firms have a strong presence in Vietnam, capturing 80 percent market share worth $48 billion. While ocean shipping services are dominated by joint ventures, road-shipping services are mostly handled by domestic firms. Cold chain has been identified as one of the key growth opportunities for foreign investors in Vietnam, an area where there has been significant international investment.

Preferred Freezer, a U.S.-based refrigerated warehousing firm, operates a large cold storage facility in Vietnam that is one of the most modern refrigerated warehouses in the country and utilizes state of the art automation technology as well as advanced inventory tracking methods.

Vietnam has had traditionally low investment in the rail industry leaving cost-effective bulk rail freight underutilized. There have been several plans to expand rail capacity and increased Chinese investment may promote Vietnam's rail sector. Reduced transport costs can further promote Vietnam's agricultural and seafood exports creating additional demand for refrigerated services.

The refrigerated products and services industry would be wise to monitor the state of bulk rail shipping in Vietnam to determine the market opportunity for both refrigerated rail cars and refrigerated warehouses at intermodal links and trans-shipment hubs. Furthermore, according to *Business Monitor International*, the poor state of domestic infrastructure capabilities provides strong demand for foreign construction companies.[61]

Demand

The entry of major retailers with their supermarket models and increase in exports of farming and seafood products are expected to drive demand for cold chain

services. While retailers have expanded to Vietnam in recent years, distribution networks remain underdeveloped. There is a traditional preference to eat fresh products, leaving the frozen food segment fragmented. Trade routes through Vietnam have increased air freight imports from the U.S. by an average of 19.2 percent since 2005.[62]

Kenya/East Africa

Kenya and the other members of the East African Community (Tanzania, Rwanda, Uganda and Burundi) are making progress in improving their regulatory environment, and may have great long term potential. However, the massive amount of infrastructure investments necessary, combined with the risk of government change and the limited market size currently put this region in the lower half on our top market survey.

Competitiveness Index	Score
Government/Regulatory	3.8
Labor Force	4.4
Infrastructure	3.8
Demand	4.3

Economic Statistics	
Population	45 Million
Cold Storage Capacity	N/A
Pharmaceutical Sales	$724 Million
Mass Grocery Sales	$1.8 Billion
Food and Drink Imports	N/A

In Sub-Saharan Africa, nearly 94 percent of all wasted food is a direct result of insufficient supply chains.[63] As such, the Middle East and Africa is a significant long-term expansion goal for many food franchises. To date, investment has been centered in the Middle East, North Africa and South Africa. In the past few years, however, franchises have begun to look at underdeveloped markets, such as Kenya as an expansion opportunity. While franchises such as Yum! Brands already have locations in several Sub-Saharan markets, the area remains largely underdeveloped.

Kenya has increasingly become an important player in global food markets with a thriving vegetable export industry. This is largely due to Kenya's location near many shipping routes and increasing capabilities of food processers and producers. According to *Business Monitor International*, the organized food retail sector is relatively well-developed in East Africa and is far superior to the retail networks of surrounding countries.

Given Kenya's relatively developed food retail industry, there is substantial opportunity for Kenyan firms to set up significant ventures in surrounding countries such as Uganda and Tanzania. Stronger food retail networks can bolster the East African Community's trade numbers and promote development within the region.

The U.S. Government should continue to use commercial dialogues to push for needed regulatory reforms, and adoption of international best practices in cold chain. ITA will perform a fact finding mission to determine what investment opportunities might exist, and what changes need to happen to attract private industry.

Government/Regulatory

The lack of clear food safety regulations is a major concern for cold chain operators. Across Africa, cold chain providers are often hesitant to invest in the market due to a lack of transparency in government regulations that sometimes can generate an appearance of corruption.

Infrastructure

Rural distribution for food products is based on informal networks where firms such as Coca-Cola and Unilever employ locals to take goods to consumers. While these distribution networks are somewhat functional, they are often not efficient. Exporters that can make large investments in distribution networks to supply the mass market may therefore develop a competitive advantage.[64]

There is significant opportunity for Kenya to increase the competiveness of its exports though investment in ports. Congestion is sometimes an issue, and some shippers have spent a premium on airfreight to avoid congestion. Uganda has also complained of theft of transit cargo at the Port of Mombasa.[65]

A fact finding visit with the Global Cold Chain Alliance is being planned for October 2015 to seek information on opportunities to develop the cold chain infrastructure in Kenya.

Labor Force

Beyond infrastructure, better integrating farmers into supply chains is critical. For example, many tomatoes in Kenya are grown as a subsistence product; increasing the market-oriented production of this commodity will require public-private partnerships. According to researchers from Egerton University, poor product quality and poor health standards are an impediment to the agricultural export industry.[66]

Furthermore it was recommended that the government partner with financial institutions to modernize the production processes of farmers. There is significant opportunity for microfinance institutions to invest in developing the capabilities of Kenyan farmers, expanding prospects for cold chain system development in Kenya.

Demand

Franchisers have found that product costs are often high in Kenya. Furthermore, consumers are often poorer outside of South Africa. Increasing cold chain efficiency can help Kenya and East Africa to become a larger player in global agriculture market.[67]

Appendix 1: Methodology

Key Market Assessment Requirements

U.S. businesses engaged in international cold chain activity assess markets against specific criteria when selecting locations for expansion. The four primary criteria include the governmental regulatory environment; whether there is a trainable skilled labor force; the infrastructure environment; and the potential demand within the country or region.

Government/Regulatory
The first aspect that U.S. industries consider when looking at a new market is the regulatory environment of the country. In particular, U.S. industry looks for a stable government with transparent policymaking and for Sanitary and Phytosanitary (SPS) regulations and food safety requirements that are grounded in science based standards and industry best practices. Legal frameworks that allow companies to resolve legal disputes and challenge regulations are essential when identifying potential export markets.

Labor Force
Another important aspect for market decision-making is the quality and skill levels of the potential work force in the market. Industry must have the capacity to train and develop the talent and the management required to run an efficient supply chain operation.

Infrastructure
The infrastructure within a country is another top aspect in the decision-making process. Electricity and IT infrastructure must be sufficient to support logistics operations. Transportation infrastructure must be of a level capable of supporting the reliable distribution of product within the country or region without excessive delays. The International Association of Refrigerated Warehouses has noted a strong correlation of cold storage capacity to a country's transportation score in the World Economic Forum's Transport Index.[68]

Demand
Finally, the demand within a country must be considered. The potential size of the market will depend on consumer wants and needs, the number of consumers of the country, products produced and demanded by the market, as well as the level of development within the market.

Methodologies

When determining which global markets policy-makers should target for export promotion and trade policy activities, it is important to account for the primary decision-making criteria of U.S. businesses engaged in the cold chain market. In this report and the case studies that follow, the criteria for evaluating markets was based on the four specific aspects of *Government/Regulations*, *Labor Force*, *Infrastructure* and *Demand*. These are reflected in the created scorecard and country case studies.

The scorecard developed for this report is based on the competitiveness index created by the World Economic Forum. By using this competitiveness index a cross-country analysis of these primary aspects is made possible. Particular aspects of the index were used to represent the primary criteria that industry indicated as a priority in market selection.

The scorecard assigns a numeric value to each of the criteria on a scale of 1-7 with 7 being the best score that can be received in a particular category. The scorecard is color coded from green to red based on comparative values of countries in the same categories. It is important to note that the color scale of yellow and red does not necessarily represent a poor environment but rather represents the lower 40 percent of scores in the given region.

The case studies of this report analyze selected potential markets and assess important competitiveness factors. These case studies are intended to aid the International Trade Administration in promoting the

development of efficient international cold chains to improve U.S. export opportunities. Inclusion or omission of countries in the case studies section does not necessarily indicate that these are the highest-ranked countries of opportunity, but rather that there has been interest expressed from government or private sector to the Supply Chain Team at the International Trade Administration in exploring these countries.

Appendix 2: Scorecards

Cold Chain Competitiveness Scorecard: Americas[69]

Criteria (1 - 7 Best)	U.S.	Brazil	Canada	Mexico
Government/Regulatory	**4.3**	**2.8**	**4.9**	**3.4**
Ethics and corruption	4.3	2.4	5.3	2.7
Legal framework in settling disputes	4.9	3.2	5.5	3.3
Legal framework in challenging regulations	4.4	3.1	4.8	3.1
Transparency of government policymaking	4.4	3.2	5.1	3.9
Foreign competition	4.5	3.2	4.9	4.4
Burden of government regulation	3.4	1.9	3.8	2.9
Labor Force	**5.5**	**4.1**	**5.2**	**3.8**
Flexibility	5.2	3.8	5.1	4.2
Country capacity to attract talent	5.8	3.6	5.2	3.3
Country capacity to retain talent	5.7	3.9	4.8	3.5
Reliance on professional management	5.7	4.6	5.9	4.1
On-the-job training	5.3	4.4	5.0	4.1
Infrastructure	**5.8**	**4.3**	**5.7**	**4.4**
Electricity and telephony infrastructure	5.8	4.5	5.8	3.9
Transport infrastructure	5.8	3.5	5.7	4.5
Technological adoption	5.8	4.8	5.6	4.9
Demand	**5.6**	**4.7**	**4.9**	**4.5**
Domestic market size	7.0	5.7	5.4	5.5
Control of international distribution	5.3	4.2	4.5	4.0
Local supplier quantity	5.5	5.1	5.0	4.7
State of cluster development	5.4	4.6	4.8	4.1
Quality of Demand Conditions	5.0	4.1	4.9	4.1
Total Score	**5.3**	**4.0**	**5.2**	**4.0**

The cold chain system in North America is well-established in both the United States and Canada. Mexico has a large, growing market for fresh foods and is seeing rapid growth in the development of its cold chain systems. Brazil has a large domestic market saturated with retail establishments, especially in large urban areas, but burdens of government regulations and transparency of government have thus far limited cold chain expansion.

Cold Chain Competiveness Scorecard: Asia[70]

Criteria (1 - 7 Best)	Australia	China	India	Indonesia	Japan	Malaysia	Singapore	Thailand	Vietnam
Government/Regulatory	**4.3**	**4.1**	**3.8**	**4.0**	**4.7**	**5.1**	**5.7**	**3.6**	**3.5**
Ethics and corruption	5.1	4.0	3.4	3.5	5.4	4.8	6.2	2.7	3.2
Legal framework in settling disputes	4.8	4.1	3.8	4.1	5.2	5.3	6.2	3.8	3.4
Legal framework in challenging regulations	4.1	3.6	3.8	3.8	4.4	4.8	4.4	3.3	3.2
Transparency of government policymaking	4.3	4.5	4.0	4.2	5.3	5.2	6.1	3.7	3.5
Foreign competition	4.7	4.1	3.9	4.3	4.6	5.5	6.3	4.9	4.7
Burden of government regulation	2.8	4.1	3.6	4.0	3.5	5.0	5.2	3.3	3.1
Labor Force	**4.7**	**4.3**	**4.1**	**4.4**	**4.7**	**5.2**	**5.7**	**4.2**	**3.6**
Flexibility	4.1	4.4	4.5	3.7	5.0	5.1	6.1	4.1	4.3
Country capacity to attract talent	4.8	4.2	3.8	4.3	3.3	5.0	6.0	3.9	3.4
Country capacity to retain talent	4.2	4.2	3.9	4.2	4.4	5.1	5.2	4.1	3.2
Reliance on professional management	5.6	4.6	4.2	5.0	5.5	5.6	6.0	4.5	3.5
On-the-job training	4.9	4.3	4.1	4.6	5.5	5.4	5.4	4.3	3.6
Infrastructure	**5.6**	**4.6**	**3.8**	**4.6**	**6.0**	**5.5**	**6.4**	**4.7**	**3.8**
Electricity and telephony infrastructure	6.0	4.3	2.6	4.2	6.2	5.2	6.5	4.5	4.0
Transport infrastructure	5.2	5.0	4.5	4.5	6.1	5.7	6.6	4.6	3.5
Technological adoption	5.6	4.5	4.2	5.0	5.7	5.6	6.0	4.9	4.0
Demand	**4.6**	**5.1**	**4.7**	**4.6**	**5.8**	**5.1**	**4.7**	**4.6**	**3.9**
Domestic market size	5.1	6.8	6.2	5.3	6.1	4.6	4.3	4.8	4.4
Control of international distribution	4.1	4.5	4.2	4.4	5.6	5.2	4.1	4.4	3.7
Local supplier quantity	5.3	5.1	4.6	4.3	6.2	5.2	5.1	5.0	4.1
State of cluster development	4.2	4.6	4.5	4.5	5.3	5.3	5.1	4.2	3.8
Quality of Demand Conditions	4.3	4.4	3.9	4.4	5.8	5.2	5.0	4.8	3.7
Total Score	**4.8**	**4.5**	**4.1**	**4.4**	**5.3**	**5.2**	**5.6**	**4.3**	**3.7**

Asia offers a great opportunity for growth in the cold chain industry. Countries like Japan, Malaysia, Singapore, and Australia have well-established infrastructure and a regulatory environment that does not severely limit commercial activity. Countries like China and India have great opportunities for growth due to their large population, but Thailand, Vietnam and Indonesia all pose particular challenges for the cold chain industry.

Cold Chain Competitiveness Scorecard: Rest of the World[71]

Criteria (1 - 7 Best)	Germany	Kenya	Netherlands	Poland	UAE	U.K.
Government/Regulatory	**4.8**	**3.8**	**5.2**	**3.5**	**5.4**	**5.1**
Ethics and corruption	5.2	3.1	5.7	3.6	6.2	5.4
Legal framework in settling disputes	5.4	4.1	5.5	2.9	5.2	5.7
Legal framework in challenging regulations	4.8	3.8	5.2	2.9	4.7	5.1
Transparency of government policymaking	4.8	4.1	5.2	3.6	5.4	5.2
Foreign competition	5.0	4.3	5.8	4.9	5.8	5.3
Burden of government regulation	3.6	3.6	3.9	2.9	5.2	3.9
Labor Force	**5.0**	**4.4**	**5.2**	**3.6**	**5.6**	**5.4**
Flexibility	4.2	4.9	4.6	4.4	6.0	5.3
Country capacity to attract talent	4.7	3.7	4.8	2.5	5.9	5.9
Country capacity to retain talent	5.1	3.8	4.8	2.7	5.5	5.0
Reliance on professional management	5.5	4.8	6.1	4.2	5.5	5.8
On-the-job training	5.5	4.6	5.6	4.4	5.2	5.2
Infrastructure	**5.9**	**3.8**	**6.0**	**4.3**	**6.2**	**5.9**
Electricity and telephony infrastructure	6.1	2.8	6.2	5.1	6.0	6.4
Transport infrastructure	6.0	3.7	6.3	3.4	6.6	5.6
Technological adoption	5.6	4.9	5.6	4.4	6.1	5.8
Demand	**5.5**	**4.3**	**5.0**	**4.2**	**5.0**	**5.2**
Domestic market size	5.8	3.5	4.7	4.9	4.0	5.7
Control of international distribution	5.2	4.4	4.7	3.6	5.3	4.7
Local supplier quantity	6.0	5.2	5.7	5.0	5.3	5.5
State of cluster development	5.5	4.2	5.3	3.5	5.5	5.2
Quality of Demand Conditions	4.8	4.2	4.8	4.0	5.1	4.9
Total Score	**5.3**	**4.1**	**5.4**	**3.9**	**5.6**	**5.4**

Most EU countries including the United Kingdom, Germany and the Netherlands are well-established with efficient cold chain systems. The United Arab Emirates has an environment that is prime for cold chain expansion opportunities and will likely see increased interest from retailers and franchisors in the near-term. Kenya and East African countries have good opportunity to expand based on potential export demand; however, infrastructure and government/regulatory barriers will need to be overcome.

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